

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, and 15 are rejected under 35

U.S.C. 102(b) as being anticipated by Fields et al (U.S. Pat. No. 6,077,401).

Fields teaches a nanocarbon producing apparatus comprising a graphite target housed in a reaction chamber (column 5, lines 25-27; column 5, lines 56—60).

Fields teaches a reaction chamber consisting of a quartz window to admit the light source and a dry ice trap to condense carbon vapors as soot (column 5, lines 59-60; column 6, lines 10-11).

Regarding claims 2, 3, 5, 6, 7, 10, 11, 12, 13, 14, and 15 Fields teaches a secondary concentrator that reflects and concentrates light. Fields teaches the secondary concentrator is located between a quartz window and a tantalum shield (column 5, lines 22-23; column 5, lines 27-28).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

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Claims 8, 9, 16, 17, 18, 19, and 20 rejected under 35 U.S.C. 103(a) as being unpatentable over Fields as applied to claims 1, 2, 3, 4, and 5 above and in further view of Kokai et al. (Growth Dynamics of Single-Wall Carbon Nanotubes and Nanohorn Aggregates by CO₂ Laser Vaporization at Room Temperature, Applied Surface Science; 197-198 Pages 650-655; 2002) and Iijima et al. (Nano-Aggregates of Single-Walled Graphitic Carbon Nano-Horns, Chemical Physics Letters; 309 Pages 165-170; 1999).

Fields teaches a nanocarbon producing apparatus comprising a chamber, graphite target, window unit, light source, recovery unit and shielding member. Fields also teaches a rod, button, shaped, or powdered graphite targets. Fields does not teach a laser light source or a rotating graphite target.

Kokai teaches formation of nanotubes using laser vaporization on a rotating graphite target (paragraph 1, lines 3-5; paragraph 4, lines 6-9). Kokai teaches temperature and air pressure affect the diameter and length of single-wall carbon nanotubes (SWNTs) and single-wall carbon nanohorns (SWNHs) (paragraph 12, lines 1-9; paragraph 14, lines 25-36).

Iijima teaches rotating a graphite target rod to continuously expose a fresh target surface to the laser beam.

It would have been obvious to one of ordinary skill in the art at the time of the invention to rotate a graphite target and use a laser as a light source because it would expose a larger surface area of sample to a power source that is constant and easy to control thereby producing a larger yield with a constant morphology.

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Claims 1, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iijima et al. (Nano-Aggregates of Single-Walled Graphitic Carbon Nano-Horns, Chemical Physics Letters; 309 Pages 165-170; 1999) in view of Toshiyuki et al. (Japan Publication No. 06-002115).

Iijima et al. teach forming single-walled graphitic carbon nano-horns using an apparatus comprising a graphite target, laser source, vacuum chamber, a ZnSe lens system for adjustment of the laser beam intensity, and a collection filter to collect the single-walled graphitic carbon nano-horns (paragraph 4). Examiner takes the position the "lens system" functions as a window unit for the laser beam to enter the vacuum chamber. Additionally, Iijima teaches a graphite target rod that is rotated about its axis (paragraph 5, line 5). Iijima does not teach a shielding member located between the lens system (window unit) and the graphite target.

Toshiyuki et al. teach a vacuum chamber with a shield that would meet the requirements for the method described by Iijima (abstract). Toshiyuki et al. teaches a "conventional laser beam machine" for laser vaporization of a target comprising a laser, a window, and vacuum chamber (paragraph 2). Additionally, Toshiyuki et al. teach a shield located between the chamber window and the target to be vaporized (paragraph 6). The shield minimizes the amount of vaporized product deposited on the window and reduced cleaning frequency of the window (paragraph 4).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the apparatus of Iijima et al. for forming single-walled

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graphitic carbon nano-horns by providing the vacuum chamber with a shielding plate between the graphite target and the window unit, as taught by Toshiyuki et al., to reduce the amount of the material to be deposited on the chamber window because it minimizes the amount of vaporized product deposited on the window , thus minimizes the maintenance of the chamber window.

Claims 1-6, 8-12 and 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iijima et al. and in further view of Yukishige et al. (Japan Patent No. 61-291966).

Iijima et al. teach forming single-walled graphitic carbon nano-horns using an apparatus comprising a graphite target, laser source, vacuum chamber, a ZnSe lens system for adjustment of the laser beam intensity, and a collection filter to collect the single-walled graphitic carbon nano-horns (paragraph 4). Examiner takes the position the "lens system" functions as a window unit for the laser beam to enter the vacuum chamber. Additionally, Iijima teaches a graphite target rod that is rotated about its axis (paragraph 5, line 5). Iijima does not teach a shielding member located between the lens system (window unit) and the graphite target.

Yukishige et al. teach a laser evaporation device comprising a chamber, laser, window, protective pipe, and reflecting mirror (abstract). Yukishige et al. teach a protective pipe located between the laser and sample to be vaporized (abstract). Yukishige teaches introducing gas into the pipe to prevent the sticking of vapor deposition material onto the window (abstract). Yukishige et al. teach passing a

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light beam through the hollow pipe onto a mirror for reflecting the beam onto a target.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the apparatus of Iijima et al. for forming single-walled graphitic carbon nano-horns by providing the vacuum chamber with a protective pipe around a part of the laser between the window and the target, as taught by Yukishige et al., to prevent the sticking of vapor deposition material onto the window.

It would have been obvious to one of ordinary skill in the art at the time of the invention to have further modified the apparatus of Iijima et al. by providing a reflecting mirror such as a parabolic mirror in the chamber, as taught by Yukishige et al., as used to reflect the laser beam onto the target.

Claims 6, 7 and 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iijima et al. in view of Yukishige et al. as applied to claims 3-5 above, and further in view of Yoshida et al (Pat No. JP61079765A).

Yoshida teaches a laser deposition device comprising a laser beam projected through an optical window onto a concave mirror to condense the beam (abstract).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the apparatus of the references as combined by providing the reflecting mirror as a focusing concave mirror such as a parabolic

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mirror, as taught by Yoshida et al., to focus the laser beam onto the rotating graphite target to efficiently use the laser beam.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GUINEVER S. GREGORIO whose telephone number is (571)270-5827. The examiner can normally be reached on Monday-Thursday, 10:30-5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on 571-272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service

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Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

gsg

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/Melvin C Mayes/
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